

CLAIMS

What is claimed is:

1. A method for binding a computer program to an analog physical signature device to define an interactive system that controls the use of the computer program for its intended purpose, the method comprising the steps of:

(a) providing instructions comprising the computer program, the instructions implementing an intended functionality;

(b) providing the analog physical signature device to which the computer program is to be bound, the analog physical signature device being operative, in response to an analog input, to transform the analog input into a consequent, dependent analog output; and

(c) replacing a code segment of the computer program instructions representing a program expression with an alternative code segment, the alternative code segment defining a predetermined digital input that is causally related to a predetermined analog input by means of the interactive system;

(d) the alternative code segment being operative, when encountered during execution of the instructions comprising the computer program, to cause the predetermined analog input to be communicated to the physical object by means of the interactive system;

(e) the analog physical signature device being operative to transform the predetermined analog input to a consequent, dependent analog output that is causally related to a predefined digital output by means of the interactive system;

(f) the alternative code segment being operative to perform program functionality dependent upon the predetermined digital input and the predefined digital output.

2. The method of claim 1 wherein the computer program implements the intended functionality after replacement of the code segment with the alternative code segment if and only

3 if the computer program is bound to the analog physical signature device such that the alternative
4 code segment is operative, using the predefined digital output causally related to operation of the
5 bound analog physical signature device, to realize the functionality of the replaced code segment.

1 3. The method of claim 1 wherein the computer program does not implement the intended
2 functionality after replacement of the code segment with the alternative code segment if the
3 computer program is bound to any other analog physical signature device since the alternative
4 code segment is operative, using any other predefined digital output causally related to operation
5 of any such other bound analog physical signature device, to realize functionality other than the
6 functionality of the replaced code segment.

1 4. The method of Claim 1 wherein the predefined consequent, dependent analog output of
2 the analog physical signature device to which the computer program is bound is unique among all
3 similar analog physical signature devices for the predetermined analog input.

1 5. The method of claim 1 wherein the interactive system includes a digital-to-analog
2 conversion means that is operative to provide the causal relationship between the predetermined
3 digital input and the predetermined analog input.

1 6. The method of claim 1 wherein the interactive system includes an analog-to-digital
2 conversion means that is operative to provide the causal relationship between the consequent,
3 dependent analog output and the consequent, dependent digital output.

1 7. The method of claim 1 wherein the replaced program expression is a program constant.

- 1 8. The method of claim 7 wherein the replaced program constant is a computational
2 constant.
- 1 9. The method of claim 7 wherein the replaced program constant is a logical constant.
- 1 10. The method of claim 7 wherein the replaced program constant is a representational
2 constant.
- 1 11. The method of claim 7 wherein the replaced program constant is a message constant.
- 1 12. The method of claim 1 wherein the replaced program expression is a program variable.
- 1 13. The method of claim 12 wherein the replaced program variable is an input variable.
- 1 14. The method of claim 12 wherein the replaced program variable is an intermediate result
2 variable.
- 1 15. The method of claim 12 wherein the replaced program variable is a pointer variable.
- 1 16. The method of claim 12 wherein the replaced program variable is an output variable.
- 1 17. The method of claim 1 wherein the replaced program expression is a program function.
- 1 18. The method of claim 17 wherein the replaced program function is an offset function.
- 1 19. The method of claim 17 wherein the replaced program function is a size function.

- 1 20. The method of claim 17 wherein the replaced program function is a format function.
- 1 21. The method of claim 17 wherein the replaced program function is a mathematical or
2 scientific function.
- 1 22. The method of claim 1 wherein the bound analog physical signature device comprises a
2 relatively complex, immutable, inhomogeneous material that is operative to transform radiant
3 waves such that the predetermined analog input is a predetermined radiant wave and the
4 consequent, dependent analog output is a consequent, dependent radiant wave.
- 1 23. The method of claim 22 wherein the relatively complex, immutable, inhomogeneous
2 material is operative to transform waves in the acoustic spectrum such that the predetermined
3 analog input is a predetermined wave input in the acoustic spectrum and the consequent,
4 dependent analog output is a consequent, dependent wave output in the acoustic spectrum.
- 1 24. The method of claim 23 wherein the relatively complex, immutable, inhomogeneous
2 material is a solid block.
- 1 25. The method of claim 23 wherein the relatively complex, immutable, inhomogeneous
2 material is a closed hollow container filled with a viscous fluid.
- 1 26. The method of claim 23 wherein the relatively complex, immutable, inhomogeneous
2 material is a disc of porous sintered metal.

1 27. The method of claim 23 wherein the relatively complex, immutable, inhomogeneous
2 material is a closed hollow container filled with ringing metal objects.

1 28. The method of claim 23 wherein the relatively complex, immutable, inhomogeneous
2 material comprises a membrane stretched over a rigid structure.

1 29. The method of claim 22 wherein the relatively complex, immutable, inhomogeneous
2 material is operative to transform waves in the electromagnetic spectrum such that the
3 predetermined analog input is a predetermined wave input in the electromagnetic spectrum and
4 the consequent, dependent analog output is a consequent, dependent wave output in the
5 electromagnetic spectrum.

1 30. The method of claim 29 wherein the relatively complex, immutable, inhomogeneous
2 material that is operative to transform light waves such that the predetermined analog input is a
3 predetermined light wave input and the consequent, dependent analog output is a consequent,
4 dependent light wave output.

1 31. The method of claim 30 wherein the relatively complex, immutable, inhomogeneous
2 material is a solid translucent rod having small reflective flakes embedded therein.

1 32. The method of claim 30 wherein the relatively complex, immutable, inhomogeneous
2 material is a solid translucent rod having small translucent colored spheres embedded therein.

1 33. The method of claim 30 wherein the relatively complex, immutable, inhomogeneous
2 material is a glass mirror having impurities embedded therein.

1 34. The method of claim 30 wherein the relatively complex, immutable, inhomogeneous
2 material is a glass mirror having surface irregularities.

1 35. The method of claim 30 wherein the relatively complex, immutable, inhomogeneous
2 material is a glass mirror having an inhomogeneous metallic backing.

1 36. The method of claim 1 wherein the replacing step comprises:
2 replacing a plurality of code segments of the computer program instructions representing
3 a corresponding plurality of program expressions with alternative code segments, each alternative
4 code segment defining a predetermined digital input that is causally related to a predetermined
5 analog input by the interactive system such that each of the alternative code segments is operative
6 to perform program functionality dependent upon the predetermined digital input and the
7 predefined digital output associated with each such alternative code segment.

1 37. An interactive system for binding a computer program, the computer program including
2 instructions for implementing an intended functionality, the interactive system comprising:
3 an analog physical signature device that is operative to transform an analog input into a
4 consequent, dependent analog output;
5 an alternative code segment that replaces a code segment of the computer program
6 instructions representing a program expression to bind the computer program to the analog
7 physical signature device, the alternative code segment defining a predetermined digital input;
8 a digital-to-analog conversion means in communication with the computer program and
9 the analog physical signature device and operative to causally relate the predetermined digital
10 input to a predetermined analog input that is communicated to the analog physical signature
11 device wherein the predetermined analog input is transformed into a consequent, dependent
12 analog output; and

13 an analog-to-digital conversion means in communication with the computer program and
14 the analog physical signature device and operative to causally relate the consequent, dependent
15 analog output to a predefined digital output;
16 the alternative code segment including instructions for communicating the predetermined
17 digital input to the digital-to-analog conversion means, for retrieving the predefined digital output
18 from the analog-to-digital conversion means, and for functionally processing the predefined
19 digital output;
20 wherein, when the alternative code segment is encountered during execution of the
21 computer program instructions, the alternative code segment is operative to communicate the
22 predetermined digital input to the digital-to-analog conversion means and to perform program
23 functionality dependent upon the predetermined digital input and the predefined digital output
24 retrieved from the analog-to-digital conversion means.

1 38. The interactive system of claim 1 wherein the analog physical signature device comprises:
2 a relatively complex, immutable, inhomogeneous material that is operative to transform
3 the predetermined analog input into the consequent, dependent analog output;
4 means in communication with the digital-to-analog conversion means and operative to
5 interact the analog input with the relatively complex, immutable, inhomogeneous material; and
6 means for detecting the consequent, dependent analog output from the relatively complex,
7 immutable, inhomogeneous material.

1 39. The interactive system of claim 38 wherein the relatively complex, immutable,
2 inhomogeneous material is operative to transform radiant waves such that the predetermined
3 analog input is a predetermined radiant wave input and the consequent, dependent analog output
4 is a consequent, dependent radiant wave output.

1 40. The interactive system of claim 39 wherein the radiant waves are in the electromagnetic
2 spectrum such that the predetermined radiant wave input is a predetermined wave input in the
3 electromagnetic spectrum and the consequent, dependent wave output is a consequence,
4 dependent wave output in the electromagnetic spectrum.

1 41. The interactive system of claim 40 wherein the radiant waves in the electromagnetic
2 spectrum are light waves such that the predetermined wave input in the electromagnetic spectrum
3 is a predetermined light wave input and the consequent, dependent wave output in the
4 electromagnetic spectrum is a consequent, dependent light wave output.

1 42. The interactive system of claim 41 wherein the relatively complex, immutable,
2 inhomogeneous material is a solid translucent rod having small reflective flakes embedded
3 therein that is operative to transform the predetermined light wave input into the consequent
4 dependent light wave output.

1 43. The interactive system of claim 41 wherein the relatively complex, immutable,
2 inhomogeneous material is a solid translucent rod having small translucent colored spheres
3 embedded therein that is operative to transform the predetermined light wave input into the
4 consequent dependent light wave output.

1 44. The interactive system of claim 41 wherein the relatively complex, immutable,
2 inhomogeneous material is a glass mirror having impurities embedded therein that is operative to
3 transform the predetermined light wave input into the consequent dependent light wave output.

1 45. The interactive system of claim 41 wherein the relatively complex, immutable,
2 inhomogeneous material is a glass mirror having surface irregularities that is operative to
3 transform the predetermined light wave input into the consequent dependent light wave output.

1 46. The interactive system of claim 41 wherein the relatively complex, immutable,
2 inhomogeneous material is a glass mirror having an inhomogeneous metallic backing that is
3 operative to transform the predetermined light wave input into the consequent dependent wave
4 output that is operative to transform the predetermined light wave input into the consequent
5 dependent light wave output.

1 47. The interactive system of claim 39 wherein the radiant waves are in the acoustic spectrum
2 such that the predetermined radiant wave input is a predetermined acoustic wave input and the
3 consequent, dependent wave output is a consequent, dependent acoustic wave output.

1 48. The interactive system of claim 47 wherein the relatively complex, immutable,
2 inhomogeneous material is a solid block that is operative to transform the predetermined acoustic
3 wave input to the consequent, dependent acoustic wave output.

1 49. The interactive system of claim 47 wherein the relatively complex, immutable,
2 inhomogeneous material is a closed hollow container filled with a viscous fluid that is operative
3 to transform the predetermined acoustic wave input to the consequent, dependent acoustic wave
4 output.

1 50. The interactive system of claim 47 wherein the relatively complex, immutable,
2 inhomogeneous material is a disc of porous sintered metal that is operative to transform the
3 predetermined acoustic wave input to the consequent, dependent acoustic wave output.

1 51. The interactive system of claim 47 wherein the relatively complex, immutable,
2 inhomogeneous material is a closed hollow container filled with ringing metal objects that is
3 operative to transform the predetermined acoustic wave input to the consequent, dependent
4 acoustic wave output.

1 52. The interactive system of claim 47 wherein the relatively complex, immutable,
2 inhomogeneous material comprises a membrane stretched over a rigid structure that is operative
3 to transform the predetermined acoustic wave input to the consequent, dependent acoustic wave
4 output.

1 53. The interactive system of claim 37 wherein the replaced program expression is a program
2 constant.

1 54. The interactive system of claim 53 wherein the replaced program constant is a
2 computational constant.

1 55. The interactive system of claim 53 wherein the replaced program constant is a logical
2 constant.

1 56. The interactive system of claim 53 wherein the replaced program constant is a
2 representational constant.

1 57. The interactive system of claim 53 wherein the replaced program constant is a message
2 constant.

1 58. The interactive system of claim 37 wherein the replaced program expression is a program
2 variable.

1 59. The interactive system of claim 58 wherein the replaced program variable is an input
2 variable.

1 60. The interactive system of claim 58 wherein the replaced program variable is an
2 intermediate result variable.

1 61. The interactive system of claim 58 wherein the replaced program variable is a pointer
2 variable.

1 62. The interactive system of claim 58 wherein the replaced program variable is an output
2 variable.

1 63. The interactive system of claim 37 wherein the replaced program expression is a program
2 function.

1 64. The interactive system of claim 63 wherein the replaced program function is an offset
2 function.

1 65. The interactive system of claim 63 wherein the replaced program function is a size
2 function.

1 66. The interactive system of claim 63 wherein the replaced program function is a format
2 function.

1 67. The interactive system of claim 63 wherein the replaced program function is a
2 mathematical or scientific function.

1 68. The interactive system of claim 37 wherein the computer program implements the
2 intended functionality after replacement of the code segment with the alternative code segment if
3 and only if the computer program is bound to the analog physical signature device, such that the
4 alternative code segment is operative, using the predefined digital output causally related to
5 operation of the analog physical signature device, to realize the functionality of the replaced code
6 segment.

1 69. The interactive system of claim 37 wherein the computer program does not implement the
2 intended functionality after replacement of the one code segment with the alternative code
3 segment if the computer program is bound to any other analog physical signature device since the
4 alternative code segment is operative, using any other predefined digital output causally related to
5 operation of any other bound analog physical signature device, to realize functionality other than
6 the functionality of the replaced code segment.

1 70. The interactive system of claim 37 wherein the replaced program expression and the
2 operation of the analog physical signature device in combination provide protection against
3 reverse engineering of the bound computer program.

1 71. The method of claim 1 wherein the replaced program expression and the operation of the
5 analog physical signature device in combination provide protection against reverse engineering of
the bound computer program.